SECTION-I (PHYSICS)

Single Correct Type Questions

1. At any instant the velocity of a particle of mass 1kg is $(2t^2\hat{i} + 3t\hat{j})\,\text{ms}^{-1}$. If the force acting on the particle at $t = 2\text{s}$ is $(x\hat{i} + 3\hat{j})$ N. Then the value of x will be:

(1) 3   (2) 4

(3) 6   (4) 8

2. A block of mass $m = 1$ kg slides with velocity $v = 5$ m/s on a frictionless horizontal surface and collides elastically with a uniform vertical rod as shown. The rod is pivoted about O and swings as a result of the collision making angle θ before momentarily coming to rest. If the rod has mass $M = 2$ kg and length $l = 1$ m, the value of θ is approximately (take $g = 10$ m/s^2, $\cos^{-1}(0.2) \approx 78°$)

(1) 39º   (2) 78º

(3) 102º   (4) 156º

3. A particle experiences a variable force $\vec{F} = \left(3x^2\hat{i} + 2y\hat{j}\right)$ in a horizontal x–y plane. Assume distance in meters and force is in Newton. If the particle moves from point (2, 1) to point (3, 2) in the x–y plane, then kinetic Energy changes by:

(1) 22.0 J   (2) 12.5 J

(3) 25.0 J   (4) 0 J

4. A body is projected vertically upwards from the surface of earth with a velocity sufficient enough to carry it to infinity. The time taken by it to reach height R_e is _____. (where R_e is radius of earth)

(1) $\sqrt{\dfrac{2R_e}{g}}\left[2^{3/2} - 1\right]$ (2) $\dfrac{1}{3}\sqrt{\dfrac{2R_e}{g}}\left[2^{3/2} - 1\right]$

(3) $\dfrac{1}{3}\sqrt{\dfrac{R_e}{2g}}\left[2^{3/2} - 1\right]$ (4) $\sqrt{\dfrac{R_e}{2g}}\left[2^{3/2} - 1\right]$

5. A rod PD of thermal resistance 10.0 kelvin/watt is joined at the middle of an identical rod AB as shown in figure, The end A, B and D are maintained at 150°C, 80°C and 50°C respectively. The heat current in PD is

(1) 10.2 W   (2) 5.2 W

(3) 4.2 W   (4) 7.2 W

6. Two identical positive charges Q each are fixed at a distance of '$2a$' apart from each other. Another negative point charge q_0 with mass 'm' is placed at midpoint between two fixed charges. For a small displacement along the line perpendicular to the line joining the fixed charges, the negative charge q_0 executes SHM. The time period of oscillation of negative charge q_0 will be:

(1) $\sqrt{\dfrac{4\pi^3\varepsilon_0 ma^3}{q_0Q}}$ (2) $\sqrt{\dfrac{q_0Q}{4\pi^3\varepsilon_0 ma^3}}$

(3) $\sqrt{\dfrac{2\pi^2\varepsilon_0 ma^3}{q_0Q}}$ (4) $\sqrt{\dfrac{8\pi^3\varepsilon_0 ma^3}{q_0Q}}$

7. A charge 'q' is placed at one corner of a cube as shown in figure. The flux of electrostatic field E though the unshaded area of cube surface is:

(1) $\dfrac{q}{48\in_0}$ (2) $\dfrac{q}{8\in_0}$

(3) $\dfrac{q}{24\in_0}$ (4) $\dfrac{q}{12\in_0}$

8. In the figure shown, after the switch 'S' is turned from position 'A' to position 'B', the energy dissipated in the circuit in terms of capacitance 'C' is x and charge on the capacitor $2C$ is y. The ratio $\dfrac{x}{y}$ is

(1) $\dfrac{\varepsilon}{2}$ (2) $\dfrac{\varepsilon}{3}$

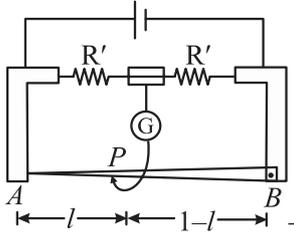(3) $\dfrac{2\varepsilon}{3}$ (4) $\dfrac{3\varepsilon}{4}$

9. In a meter bridge, the wire of length 1 m has a non-uniform cross-section such that the variation of its resistance R with length l from end A, is $\dfrac{dR}{dl} \propto \dfrac{1}{\left(l^{\frac{1}{3}}\right)}$. Two equal resistance each of value R are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P. What is the length AP i.e. l?

(1) $2^{-\frac{1}{2}}$ m

(2) $2^{-\frac{2}{3}}$ m

(3) $2^{-\left(\frac{2}{5}\right)}$ m

(4) $2^{-\frac{3}{2}}$ m

10. The magnetic field in a region is given by $\vec{B} = B_0\left(\dfrac{x^2}{a^2}\right)\hat{k}$. A square loop of side d is placed with its edges along the x and y axes. The loop is moved with a constant velocity $\vec{v} = v_0\hat{i}$. The emf induced in the loop at the position shown in the figure is _____ .
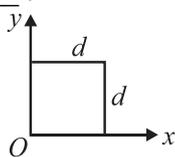
(1) $\left(\dfrac{B_0 d^3 v_0}{3a^2}\right)$

(2) $\left(\dfrac{B_0 d^3 v_0}{a^2}\right)$

(3) $\left(\dfrac{3B_0 d^3 v_0}{a^2}\right)$

(4) $\left(\dfrac{B_0 d^3 v_0}{9a^2}\right)$

11. In the given figure, the face AC of the isosceles prism is immersed in a liquid of refractive index 'n'. The refracted light beam deviates by 135°. The refractive index of the liquid is
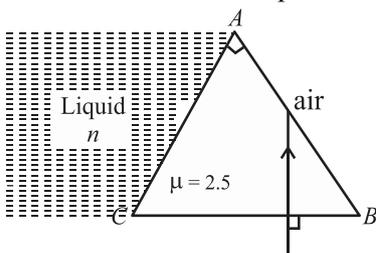
(Given refractive index of prism = 2.5)

(1) $\dfrac{2\sqrt{5}}{3}$

(2) $\dfrac{2\sqrt{2}}{5}$

(3) $\dfrac{5}{2\sqrt{2}}$

(4) $\dfrac{3}{2\sqrt{5}}$

12. A boat has velocity of 8 km/ h in still water. Water flowing in a river has velocity 6 km/ h. The width of river is $4\sqrt{7}$ km. The time taken by the boat to cross the river to reach directly opposite point on the other bank of river is.

(1) 2 hr

(2) 2.5 hr

(3) 3.2 hr

(4) 4 hr

13. In the circuit shown, $C = \dfrac{2}{\sqrt{3}}$ mF, $R_2 = 15\Omega$, $L = \dfrac{\sqrt{3}}{10}$ H and $R_1 = 10\Omega$. Current in L-R_1 path is I_1 and C-R_2 path is I_2. This voltage of A.C. source is given by 20 sin (100t) volts. Peak value of current I in the circuit is
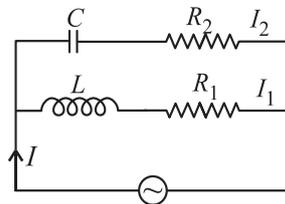
(1) $\sqrt{\dfrac{3}{7}}$ A

(2) $\sqrt{\dfrac{7}{3}}$ A

(3) $\sqrt{\dfrac{14}{3}}$ A

(4) $\sqrt{\dfrac{3}{14}}$ A

14. The material filled between the plates of a parallel plate capacitor has resistivity 100Ω m. The value of capacitance of the capacitor is 17.7 pF. If a potential difference of 10 V is applied across the plates of the capacitor, then the maximum value of leakage current flowing out of the capacitor is : (given the value of relative permittivity of material is 20, $\varepsilon_0 = 8.85 \times 10^{-12}$ in SI units)

(1) 1 μA

(2) 1 mA

(3) 10 μA

(4) 10 mA

15. There is a small source of light at some depth below the surface of water (refractive index = 4/3) in a tank of large cross sectional surface area. Neglecting any reflection from the bottom and absorption by water, percentage of light that emerges out of surface

(1) Decreases with increasing depth of source

(2) remains constant with increasing depth of source

(3) Increases with increasing depth of source

(4) May decrease or increase with increasing depth of source

16. A beam of plane polarised light of large cross-sectional area and uniform intensity of $\dfrac{20}{7}$ Wm^{-2} falls normally on a polariser (cross sectional area 7×10^{-4} m^2) which rotates about its axis with an angular speed of 15.7 rad/s. The energy of light passing through the polariser per revolution, is close to

(1) 3.0×10^{-5} J   (2) 3.0×10^{-4} J

(3) 4.0×10^{-4} J   (4) 5.0×10^{-4} J

17. The electric field of light wave is given as $\vec{E} = 10^{-3} \cos\left(\dfrac{2\pi x}{6 \times 10^{-7}} - 2\pi \times 5 \times 10^{14} t\right)\hat{y} \dfrac{\text{N}}{\text{C}}$. This light falls on a metal plate of work function 1.5 eV. The stopping potential of the photoelectrons is

Given: $hc = 12400$ evÅ

(1) 0.57 V   (2) 0.40 V

(3) 1.57 V   (4) 1.40 V

18. The radius of electron's third stationary orbit in Bohr's atom is R. The radius of 5$^{\text{th}}$ orbit will be

(1) $\dfrac{25}{9} R$ (2) $9\,R$

(3) $\dfrac{25}{16} R$ (4) $25\,R$

19. $^{238}_{92}A \rightarrow\, ^{234}_{90}B +\, ^{4}_{2}D + Q$

In the given nuclear reaction, the amount of energy released gets converted into kinetic energy of nuclei B and D, then the kinetic energy of nucleus B is : [Given, mass of $^{238}_{92}A = 238.05079$ amu, mass of $^{234}_{90}B = 234.04363$ amu, mass of $^{4}_{2}D = 4.00260$ amu] $\left[1\ \text{amu} = 931.5\ \dfrac{\text{MeV}}{c^2}\right]$

(1) 0.07 MeV   (2) 0.2 MeV

(3) 4.17 MeV   (4) 4.25 MeV

20. Each diode has a forward resistance of 48Ω and infinitely large reverse bias resistance in the below circuit. If switch S$_1$ and S$_2$ are closed.
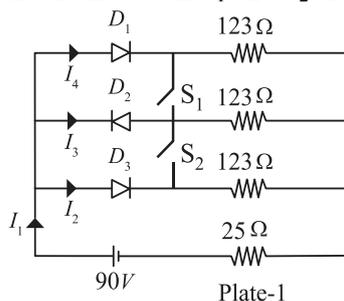
Which of the following options is correct?

(1) $I_1 = 0.9$ A   (2) $I_2 = 0.5$ A

(3) $I_3 = 1$ A   (4) $I_4 = 0.45$ A

Integer Type Questions

21. The disturbance of wave propagating in the positive x-direction is given by $y = \dfrac{1}{1 + (x)^2}$ at time $t = 0$ and $y = \dfrac{4}{4 + (2x - 8)^2}$ at $t = 1$ s, where x and y are in metres. The shape of wave does not change during the propagation. The velocity of the wave will be_____ m/s.

22. A small spherical droplet of density d is floating as shown in figure in a liquid of density ρ and surface tension T. The radius R of the droplet is $\sqrt{\dfrac{xT}{(32d - 5\rho)g}}$. Find x.

(take note that the surface tension applies an upward net force on the droplet)
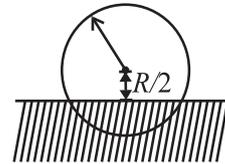
23. The radius of gyration of a uniform rod of length L, about an axis passing through a point $\dfrac{L}{5}$ away from the centre of the rod, and perpendicular to it is $\sqrt{\dfrac{x}{300}}L$. Find the value of x.

24. As per given figure A, B and C are the first, second and third excited energy level of hydrogen atom respectively. If the ratio of the two wavelengths $\left(i.e.\dfrac{\lambda_1}{\lambda_2}\right)$ is $\dfrac{n}{20}$, then the value of n will be
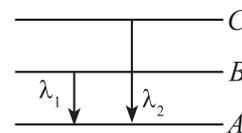

25. In a Young's double slit experiment, the intensities at two points, for the path difference $\dfrac{\lambda}{6}$ and λ (λ being the wavelength of light used) are I_1 and I_2 respectively. If I_0 denotes the intensity produced by each one of the individual slits, then $\dfrac{I_1 + I_2}{I_0} =$ ____.

SECTION-II (CHEMISTRY)

Single Correct Type Questions

26. Which of the following results would have been obtained from Rutherford 's gold foil experiment
(1) All α – particles get bounced back by 180°
(2) Through the gold foil most of the α-particles went straight
(3) All of α – particles pass through the gold foil with decrease in speed
(4) Most of the α – particles were deflected over a wide range of angles

27. Which of the following plots represent the isobaric expansion of an ideal gas?

(A) T vs $1/V_m$

(B) T vs $1/V_m$

(C) V_m vs T

(D) T vs V_m
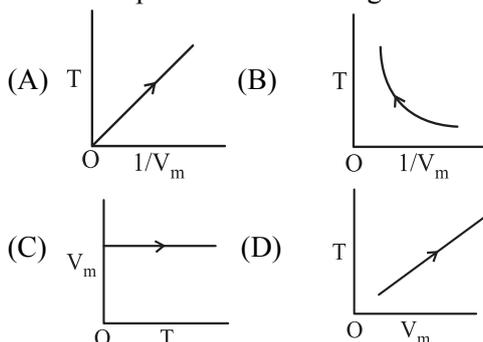
(1) (B) and (D)   (2) (A) and (C)
(3) (B) and (C)   (4) (A) and (D)

28. The reaction of Cu^{2+} with KI produces a white precipitate, P in solution. When the solution is titrated with sodium thiosulphate, the compound Q is formed. The average oxidation state of sulphur in compound Q is:
(1) +6   (2) + 1.5
(3) +2   (4) + 2.5

29. Consider the following reaction sequence

$\xrightarrow[\Delta]{HBr(excess)} A$

$\xrightarrow{(i)KOH(Alc.)} B \xrightarrow[Zn/H_2O]{O_3} C$
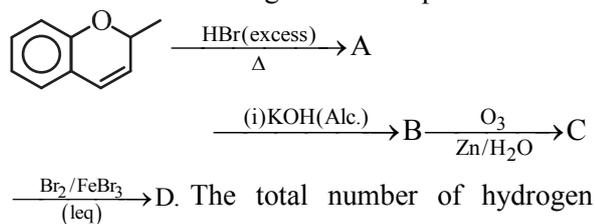
$\xrightarrow[(leq)]{Br_2/FeBr_3} D.$ The total number of hydrogen atom in compound D is:
(1) 3   (2) 4
(3) 5   (4) 6

30. Match column - I with column- II.

Column-I (Atomic number)		Column-II (Block of periodic table)	
A	49	P	p-block
B	55	Q	d-block
C	97	R	f-block
D	39	S	s-block

Choose the correct answer from the options given below:

	A	B	C	D
(1)	P	S	R	Q
(2)	Q	R	S	P
(3)	S	R	Q	P
(4)	S	Q	P	R

31. The dipole moments of CCl_4, $CHCl_3$, CH_2Cl_2 and CH_3Cl are in the order
(1) $CCl_4 < CH_3Cl < CH_2Cl_2 < CHCl_3$
(2) $CCl_4 < CH_2Cl_2 < CHCl_3 < CH_3Cl$
(3) $CH_3Cl < CCl_4 < CHCl_3 < CH_2Cl_2$
(4) $CCl_4 < CHCl_3 < CH_2Cl_2 < CH_3Cl$

32. Which among the following is the most acidic oxide?
(1) SnO_2 (2) PbO_2
(3) GeO_2 (4) SiO_2

33. The number of primary carbon atom present in the major product when excess of isobutane reacts with Br_2 in presence of light is :
(1) One   (2) Two
(3) Three   (4) Four

34. To make a dilute glucose solution at room temperature, 1.80 g of glucose is mixed with 540 g of water. Given that the vapour pressure of pure water at this temperature is 35 mm Hg, calculate how much the vapour pressure will be reduced by the glucose. (molar mass of glucose = 180 g mol^{-1})
(1) 0.027 mmHg   (2) 0.031 mmHg
(3) 0.012 mmHg   (4) 0.017 mmHg

35.
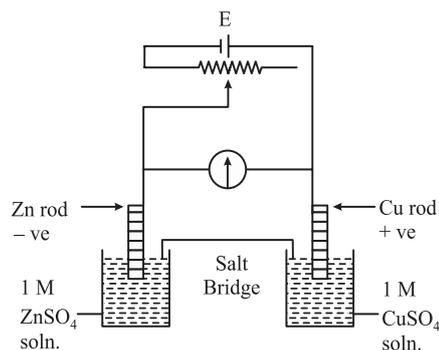
$E^o_{Cu^{2+}|Cu} = +0.34\,V$

$E^o_{Zn^{2+}|Zn} = -0.76\,V$

Identify the correct statement from the option below for the above cell.
(1) If $E_{ext} < 1.1$ V, Zn dissolves at anode and Cu deposits at cathode
(2) If $E_{ext} \geq 1.1$ V, no flow of e⁻ or current occurs
(3) If $E_{ext} > 1.1$ V, e⁻ flow occurs from Zn to Cu through external circuit.
(4) If $E_{ext} > 1.1$ V, Zn dissolve at Zn and Cu deposits at Cu electrode

36. The variation of rate constant (k) with temperature (T) for an endothermic reaction is represented by which one of the following graphs?

(1)

(2)

(3)

(4)
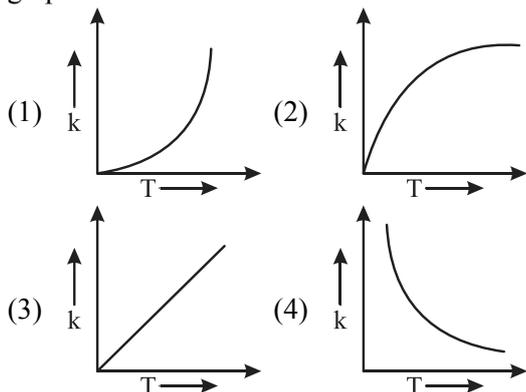
37. Which of the following elements is considered as a metal
(1) As   (2) Te
(3) Sb   (4) Bi

38. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R:
Assertion (A): Ce^{4+} is colourless due to lack of f-f transition.
Reason (R): The stable oxidation state of lanthanoids is +3.
In the light of the above statements, choose the correct answer from the options given below:
(1) A is false but R is true.
(2) A is true but R is false.
(3) Both A and R are true and R is the correct explanation of A.
(4) Both A and R are true but R is NOT the correct explanation of A

39. In copper sulphate pentahydrate, the number of water molecules inside coordinate sphere and hydrogen bonded, respectively are
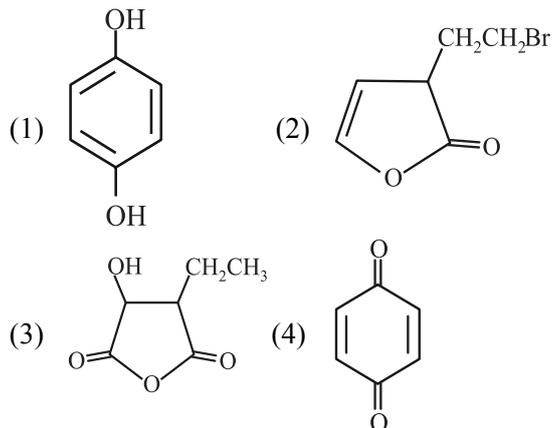(1) 6 and 4   (2) 4 and 1
(3) 5 and 1   (4) 6 and 5
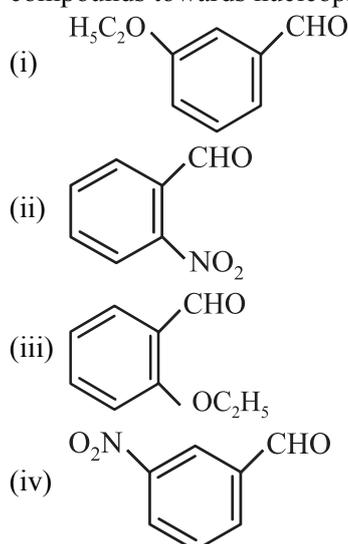
40. Consider the following reaction
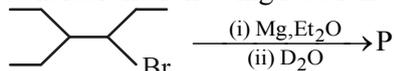
The correct structure and number of stereoisomer of compound 'P' is

(1) , Four

(2) , Three

(3) , Two

(4) , No stereoisomer

41. An organic compound 'X' with empirical formula C_6H_6O gives violet colour with neutral $FeCl_3$ solution. Its reaction with chromic acid gives a yellow compound 'Y'. The compound 'Y' is.
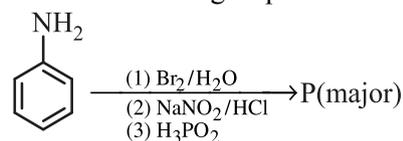
(1)

(2)

(3)

(4)

42. The correct increasing order of the following compounds towards nucleophilic addition is
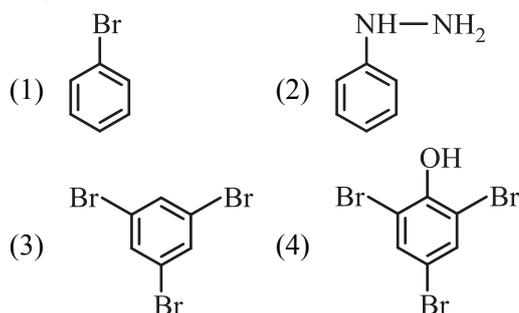
(i)

(ii)

(iii)

(iv)

(1) (iii) < (iv) < (ii) < (i)
(2) (iii) < (i) < (iv) < (ii)
(3) (iii) < (iv) < (i) < (ii)
(4) (i) < (iii) < (iv) < (ii)

43. Consider the following sequence of reactions:

P is:

(1)

(2)

(3)

(4)

[7]

44. Statement-I: Barfoed test can be used to distinguish glucose and galactose.
Statement-II: Glucose is a monosaccharide while galactose is disaccharide.
In the light of the above statements, choose the most appropriate answer from the options given
(1) Statement-I is true but statement-II is false
(2) Both Statement-I and statement-II are true
(3) Both statement -I and statement-II are false
(4) Statement-I is false but statement-II is true

45. Statement-I: In the column chromatography separation of compounds 'A' and 'B', 'A' was the first to elute. This result implies that 'A' interacts more strongly with the stationary phase than 'B' does.
Statement-II: Compound having low retention factor will have weaker interaction with stationary phase in column chromatography.
In the light of the above statements, choose the most appropriate answer from the options given
(1) Statement-I is true but statement-II is false
(2) Statement-I is true but statement-II is true.
(3) Both statement-I and statement-II are false
(4) Statement-I is false but statement-II is true

Integer Type Questions
46. In a cell, the following reactions take place
$Fe^{3+} + e^- \rightarrow Fe^{2+}; E° = 0.77\,V$

$Cu^{2+} + 2e^- \rightarrow Cu; \quad E° = 0.337\,V$
The standard electrode potential for the spontaneous reaction in the cell is $x \times 10^{-3}$ V at 298 K. The value of x is _____

47. If an organic compound follows first-order kinetics and decomposes by 40% in 44 minutes, then the time required for 90% decomposition is_____ min.
Given: $\ln 10 = 2.3$; $\log 6 = 0.78$

48. In an experiment, 46 g of benzyl trimethyl ammonium bromide are produced from the reaction of benzylamine with bromomethane. If the number of moles of bromomethane consumed are $a \times 10^{-2}$ then the value of a is_____
[Given: Atomic masses: C: 12.0 u, H : 1.0u, N : 14.0u, Br : 80.0u]

49. To prepare 50 mL of an aqueous solution with 140 mg of Na^+ per mL, the amount (in g) of $NaNO_3$ required is_____ . (Rounded off to the nearest integer)
[Given: At mass: Na = 23, N = 14, O = 16]

50. The number of isomers possible for $[Pt(en)(SCN)_2]$ is_____.

SECTION-III (MATHEMATICS)

Single Correct Type Questions
51. Let $P = \left\{a \in \mathbb{R} : [a+2]+[a+4] \le 2\right\}$

$Q = \left\{a \in \mathbb{R} : 3^a\left(\left(\sum_{r=1}^{\infty}\frac{3}{10^r}\right)^{a-3}\right) < 3^{-3a}\right\}$, where $[t]$ denotes greatest integer function. Then $P \cap Q$ is
(1) $-\infty < a < 0$
(2) $-\infty < a < -1$
(3) $1 < a < \infty$
(4) $0 < a < \infty$

52. Let the equation $28x^2 - 62x + 6m = 0$ have roots α & β and the equation $38x^2 - 38x + 2m = 3x^2 + 15x - 2m$ have roots α & γ. (where $m \ne 0$ be a real number). Then $(\alpha + m)$ and $(\gamma + \beta)$ are the roots of the equation
(1) $70x^2 - 516x + 920 = 0$
(2) $7x^2 - 561x + 920 = 0$
(3) $70x^2 - 561x + 920 = 0$
(4) $70x^2 - 561x + 290 = 0$

53. The number of distinct real solutions of the equation $\left(x^2 + \frac{1}{x^2}\right) - 5\left(x + \frac{1}{x}\right) + 8 = 0$ is
(1) 4 (2) 0
(3) 2 (4) 3

54. Let $a_1, a_2, a_3, \ldots\ldots$ be an A.P. if $a_7 = 3$, the product $a_1 a_4$ is minimum and the sum of its first n terms is zero, then $n! - 4a_{n(n+2)}$ is equal to:
(1) 24 (2) $\frac{33}{4}$
(3) $\frac{381}{4}$ (4) 9

55. Let $z_1\bar{z}(1-z) + \frac{z_1}{z} - 1 - i\bar{z} = 0$ and $z - i = 2$. Then $41z_1$ is equal to
(1) $-38 - 14i$
(2) $-38 + 14i$
(3) $38 + 14i$
(4) $38 - 14i$

56. Let $P(a, b)$ and k are the centre and radius of the circle $|z - 1| - 3|z - 2| = 0$ respectively. Then $64(a + b + 4k^2)$ is equal to

(1) 218   (2) 118

(3) 263   (4) 172

57. Let m and n are the number of arrangements of the letters of the word "INDEPENDENCE" in which all vowels occur together and all the words start with P respectively. Then $m + n$ is

(1) 155400   (2) 154400

(3) 154500   (4) 145600

58. If the shortest distance between the lines $\dfrac{x - \lambda}{-2} = \dfrac{y - 2}{1} = \dfrac{z - 1}{1}$ and $\dfrac{x - \sqrt{3}}{1} = \dfrac{y - 1}{-2} = \dfrac{z - 2}{1}$ is 1, then the sum of all possible values of λ is, m then $\dfrac{m}{\sqrt{3}}$ is

(1) 2   (2) 3

(3) 4   (4) 7

59. The value of $\displaystyle\sum_{r=1}^{26}\left(\dfrac{2r}{(2r)!\left[(51 - (2r - 1))!\right]}\right)$ is

(1) $\dfrac{51(2^{51})}{51!}$ (2) $\dfrac{51(2^{50})}{52!}$

(3) $\dfrac{52(2^{51})}{52!}$ (4) $\dfrac{2^{50}}{51!}$

60. A six digit number is formed using digits 1, 7, 7, 5, 5, 2. The probability, that the number formed is divisible by 5, is

(1) $\dfrac{1}{3}$ (2) $\dfrac{2}{3}$

(3) $\dfrac{1}{7}$ (4) $\dfrac{6}{7}$

61. Let b $(5 < b < 10)$ be the natural value of a for which the roots of the quadratic equation $8x^2 - 8ax + 10a = 0$ are rational. Then area of the region bounded by positive x-axis, positive y-axis, and the parabola $y = x^2 - 2bx + b^2$ is

(1) 240   (2) 243

(3) 343   (4) 543

62. Let $X = \begin{bmatrix} x_{11} & x_{12} & x_{13} \\ x_{21} & x_{22} & x_{23} \\ x_{31} & x_{32} & x_{33} \end{bmatrix}_{3 \times 3}$, such that $x_{ij} = \dfrac{1}{3^{i-j}}$, for all $i, j = 1, 2, 3$. Then the matrix $X + X^2 + \dots + X^{20}$ is

(1) $\dfrac{(3^{20} - 1)}{2} X$ (2) $\dfrac{(3^{20} - 1)}{3} X$

(3) $\dfrac{(3^{20} + 1)}{2} X$ (4) $\dfrac{(1 + 3^{20})}{3} X$

63. Let $Q = \dfrac{1}{3!}\begin{bmatrix} 6 & -6 \\ 12 & 24 \end{bmatrix}$ and $P = Q^T$. If $P^{-1} - bP = aI$, $a, b \in R$ (where I is 2×2 identity matrix). Then $3(a + b)$ is

(1) 3   (2) 5

(3) 2   (4) 6

64. The value of $\sin 12° + \cos 78° - \cos 18°$

(1) $\dfrac{\sqrt{5}(1 - \sqrt{3})}{4}$ (2) $\dfrac{1 - \sqrt{5}}{8}$

(3) $\dfrac{\sqrt{3}(1 - \sqrt{5})}{2}$ (4) $\dfrac{\sqrt{3}(1 - \sqrt{5})}{4}$

65. Let $\alpha = 2\cos^{-1}\left(\dfrac{5}{\sqrt{26}}\right) + \sin^{-1}\left(\dfrac{1}{\sqrt{5}}\right) + 2\tan^{-1}\dfrac{1}{8}$. Then $\tan\alpha + \cot\alpha$ is

(1) $\dfrac{10}{3}$ (2) $\dfrac{5}{2}$

(3) $\dfrac{7}{3}$ (4) 2

66. If $\displaystyle\sum_{k=0}^{119}\left(\left[\sqrt{k+1}\right]\right) = \sum_{r=1}^{n}(2r + 1)r$ (where $[\cdot]$ represent G.I.F.). Then n is

(1) 10

(2) 9

(3) 8

(4) 7

67. Let

$$f(\theta) = \begin{cases} \left(\sqrt{2 + 2\cos\theta - \sin^2\theta}\right)^{\frac{a}{|\cos\theta|}} &, & 0 < \theta < \dfrac{\pi}{2} \\ b &, & \theta = \dfrac{\pi}{2} \\ e^{\frac{\tan 4\theta}{\tan 6\theta}} &, & \dfrac{\pi}{2} < \theta < \pi \end{cases}$$

If $\displaystyle\lim_{\theta \to \frac{\pi}{2}^+} f(\theta) = \lim_{\theta \to \frac{\pi}{2}^-} f(\theta) = f\left(\dfrac{\pi}{2}\right)$. Then the quadratic equation whose roots are $3a$ and $3(a + \ln b)$

(1) $x^2 + 6x + 8 = 0$

(2) $x^2 + 4x - 8 = 0$

(3) $x^2 - 5x + 8 = 0$

(4) $x^2 - 6x + 8 = 0$

68. Let $\lambda = \dfrac{f(\lambda) + f'''(3)}{f''(2) - \lambda f'(1) + \lambda^2}, \lambda \in R.$ Then the value of $\log_3 |f(0) + f^2(1) + f^3(2) + f(3)|$ is

(1) $\log_3 2 + 3$ (2) $\log_2 3 + 1$

(3) $\log_3 2 + 2$ (4) $3 + \log_2 3$

69. If $18\int\left[\left(\cos x - \cos^3 x\right)\left(\sin^4 x + \sin^2 x + 1\right)\right.$

$$\left. \cdot \sqrt{2\sin^4 x + 3\sin^2 x + 6}\right] dx$$

$$= \left(k\sin^{3k} x + (k+1)\sin^{2k} x + 3k\sin^k x\right)^{1+\frac{1}{k}} + c'$$

(where c' is a constant of integration). Then k is

(1) 6 (2) 2

(3) 4 (4) 3

70. A function $y = f(x)$ satisfy the differential equation $\left(2\sqrt{x+1}\right)\dfrac{dy}{dx} + \dfrac{\left(2\sqrt{x+1}\right)}{x} y = 1$ and $f(3) = 2$, then

(1) $xy = \dfrac{(x+1)^3}{3} - (x+1) + \dfrac{16}{3}$

(2) $xy = \dfrac{(x+1)^{3/2}}{3} - \sqrt{x+1} - \dfrac{16}{3}$

(3) $xy = \dfrac{(x+1)^{3/2}}{3} - \sqrt{(x+1)} + \dfrac{16}{3}$

(4) $xy = \dfrac{(x+1)^2}{3} - (x+1) - \dfrac{16}{3}$

Integer Type Questions

71. Let $7x + 14 = 7y$, $8y - 6x = 12$ and $9y - 12x = 3$ be three sides of a ΔABC whose incentre is (h, k) and Inradius is r. Then $AB^2 + BC^2 + CA^2 + 2 = \lambda(h + k)$. Find λ

72. The foci of Hyperbola $a^2x^2 - 36y^2 = 4a^2$ coincide with ellipse $9x^2 + 25y^2 = 225$. If L is the sum of latus rectum of ellipse and hyperbola. Then the value of $5L$ is

73. Let $\overrightarrow{AC} = -3\hat{j} - 3\hat{k}$ and $\overrightarrow{BD} = 8\hat{i} + 5\hat{j} - \lambda\hat{k}$ are diagonals of quadrilateral $ABCD$, where $|\lambda| \le 5$. If it's area is 18 square units, then value of $15 - 10\lambda$ is

74. If the mean and variance of five observations are $\dfrac{24}{5}$ and $\dfrac{194}{25}$ respectively and the mean of first four observations is $\dfrac{7}{2}$, then the variance of the first four observations is equal to m then $4m$ is

75. In a classroom of 100 students, 75 present in English lecture and 40 present in Hindi lecture. Each students present in at least one of the two lecture. If the total number of students who are present in both lecture is $\dfrac{(k!)}{8}$. Then k is